Reports

Review of *Advanced Matrix Theory for Scientists and Engineers,** by A. S. Deif

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According to the author's preface most matrix theory books are either deep and theoretical requiring a strong mathematical background or are introductory texts. The author's aim was to write "a third kind of book which presents advanced topics in a manner accessible to scientists and engineers with an applied problem bias." Furthermore it was to be "intelligible to many readers, who need not be equipped with much mathematical background to be able to digest it."

In fact, the author has written a fourth kind of book. Perhaps the best way to describe it is "stream of consciousness." The book has its uses and the reviewer is glad that he has a copy but it is not the book described in the preface.

To begin with the book is not suitable for either self study, unless one already knows some matrix theory, or for classroom use. There are several problems.

First the material is not well organized. For example, inverse notation and determinants are used in exercises and examples early in the text but it is not until page 159 that inverses are fully discussed and solution by row operations is given. After an operation or object is defined most of its properties are developed as exercises instead of being compiled in one place. This makes use as a reference book difficult.

There also seems to be no pattern to what is discussed in detail. For example, the determinant is defined in terms of permutations and many of its properties developed from the definition in detail using multiple summation notation (pp. 11–16) whereas calculations using matrix algebra are almost never given. Of the two skills the latter is the more important to one first studying matrix theory. Exercises are often highly nontrivial. For example, "prove the Greschgorin Theorem."

There are several interesting applications but they are often unexplained. For example, exercise 39, page 9, asks the reader to compute the impedance without any prior discussion of impedance.

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Notation and terminology are often used without being defined. "Vector space" is used not just for R^n but for a subspace without being defined. The book also contains numerous false exercises, and misleading and confusing statements. We shall give a few examples. Exercises 2, 13, and 21 on pages 86–87 are either false or misleading. Exercise 2 claims A has the same eigenvectors as A^m. $A = \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix}$, $m = 2$, is a counter example. Exercise 21 is "If $AB = BA$, show that A and B have the same eigenvectors." $A = I$, B not a multiple of I is a counter example. Theorem 1, page 104, is false unless one adds the assumption A is hermitian. The Theorem on page 158 is both a definition and a theorem. Its proof could be confusing. The Theorem on page 171 should be changed to read $s(A) < R$, as stated, it is false. The condition for convergence on the bottom of page 170, $\|A_{n+1}\|/\|A_n\| < 1$, is false. $A_n = 1/n$ is a counter example. Exercise 8, page 183, asks the reader to prove something and then asks "show this result holds true only if...". This is confusing. Exercise 13, page 198, is only true if $A(t)$ is constant. On page 161, the author states that "$A^T(I - AA^i) = 0$ even if $AA^ib \neq b$," then goes on to say that to show this we must add extra assumptions on A^i. Also in discussing eigenvectors, there is often talk of *the* eigenvector. Any discussion of the fact that eigenvectors are nonunique is avoided.

The book has several discussions of numerical considerations. These are some of the better parts of the book. However, they are not consistent. For example, on pages 42–43 the determinant of the Grammian is proposed as a better way to check linear independence than solving $[x_1, \dots, x_n]c = 0$. Yet later the author correctly points out in the discussion on Cramer's rule the effort involved in taking determinants.

Having taught introductory and advanced matrix theory to both graduate and undergraduate scientists and engineers, the reviewer does not believe the book is suitable for such a course. It is also not suitable for self study by someone not already strong in matrix theory.

The book under review does have three potential uses. First, it does contain a brief discussion of several topics not usually included in an introductory course. Someone with a modest background in matrix theory might profitably pick up some ideas/techniques that would be helpful. The reader would, however, probably have to go elsewhere for more detailed information.

The large lists of problems and numerous applications could also be useful to someone teaching a matrix theory or linear algebra course as a supplementary source. In most cases, the reader would need to further research the applications and check if the exercises are correct.

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